

**SHOBHIT NIRWAN's**  
**DESIGNED**



# **METALS AND NON METALS**

**NEW NOTES FOR CLASS 10 2022 EXAMS**

**Including PYQs in MCQ Format  
NCERT Activities  
Flowchart**

# A. METALS

Those elements which form ions by losing electrons are called metals.

## Physical Properties of Metals

### **Metals are malleable that is metal beaten into thin sheets**

Malleability: The property which allows the metal to be hammered into thin sheets. It is an important characteristic of metal.

Eg: Gold and silver metals are best malleable metals.

Eg: Aluminium and Copper metal are also highly malleable metals.

Aluminium Foils are used for decorating sweets and for packing food items like biscuits, namkeens etc.

### **Metals are good conductor of Heat**

- Metal allows heat to pass through them easily.
- Silver metal is the best conductor of heat. It has highest conductivity.
- Copper and aluminium metal are also very good conductors of heat.
- The cooking utensil and water boilers are usually made of copper or aluminium because they are good conductors of heat.
- Poorest conductor of heat- Lead and Mercury

### **Metals are good conductor of Electricity**

- Metal allows electricity to pass through them easily.
- Silver metal is the best conductor of electricity.

### **Metals have high melting and boiling point**

- Iron metal has high melting point of  $1535^{\circ}\text{C}$ , this means that solid iron melts and turns into liquid on heating to a high temp.
  - Copper metal has high melting point of  $1083^{\circ}\text{C}$ .
- Exceptions:
- Sodium and potassium metal has Low melting point of  $98^{\circ}\text{C}$  and  $64^{\circ}\text{C}$ .
  - Gallium and cesium metal also has low melting point  $30^{\circ}\text{C}$  and  $28^{\circ}\text{C}$ .

### **Metals are solid at room temperature**

- Metals like iron, copper, silver, gold etc are solids at room temperature.
- Only one metal, i.e. Mercury is in liquid state at room temperature.

### Metals are Sonorous

- Sonorous means capable of producing a deep or ringing sound.
- Metals make sound when hit an object.
- The property of metals of being sonorous is called sonority.
- It is due to the property of sonorousness that metals are used for making bells and strings of musical instrument like sitar and violin.

### Metals are Strong

- Metal can hold large weight without snapping (without breaking) .
- Iron Metal used in construction of bridges buildings and railway line.
- Exception- sodium and potassium metal are not strong enough.

### Metals are Ductile

- Ductility- The property which allows the metal to be drawn into thin wire
- Gold is the most ductile metal and silver are among the best ductile metal.
- Copper and aluminium metals are very ductile and drawn into thin copper and Aluminium wires.
- Magnesium metals are used in experiment in the laboratory and Tungsten metal are used for making the Filament of electric bulb.

## Chemical Properties of Metals

### Reaction of Metals with Oxygen

( metal + oxygen → metal oxide)

- $4\text{Na(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{Na}_2\text{O(s)}$   
sodium          oxygen          sodium oxide
- $4\text{Al(s)} + 3\text{O}_2\text{(g)} \rightarrow 2\text{Al}_2\text{O}_3\text{(s)}$   
(Aluminium oxide)
- $2\text{Cu(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{CuO(s)}$   
(copper oxide)
- $\text{Zn(s)} + 2\text{HCl} \rightarrow \text{ZnO}$   
Zinc Oxide
- $3\text{Fe(s)} + 2\text{O}_2\text{(g)} \rightarrow \text{Fe}_3\text{O}_4\text{(s)}$   
Iron(II, III) oxide



### L.P. : Why Potassium and sodium metal are stored under Kerosene oil?

- The potassium and sodium metal are so reactive that they react vigorously with Oxygen (of air).
  - They catch fire and start burning when kept in air.
- So, it is kept in Kerosene to prevent their reaction with the  $\text{O}_2$  moisture and  $\text{CO}_2$  of air.



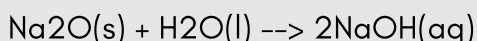
### Kuch Kaam Ki Baat (K<sup>3</sup>B) :

Upar Vali Reactions me hume product Metal Oxides mile, to chalo thoda metal oxides ke baare me padh lete hai ;)

#### REACTIONS OF METAL OXIDES

**1.** Most of the metal oxides are insoluble in water. But some of the metal oxides dissolve in water to form alkalis.

- Sodium oxide is a basic oxide which reacts with water to form an alkali called sodium hydroxide.



Due to formation of NaOH alkali, a solution of sodium oxide in water turns red litmus to blue

- Potassium oxide is also a basic oxide which reacts with water to form an alkali called potassium hydroxide.



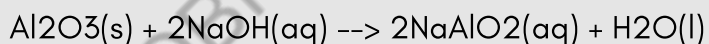
**2.** Those metal oxides which show basic as well as acidic behaviour are called Amphoteric oxide. Aluminium metal and Zinc metal form amphoteric oxide, aluminium oxide and zinc oxide are amphoteric in nature.

- Aluminium oxide reacts with Hydrochloric acid to form aluminium chloride and water.



In this reaction aluminium oxide behaves as basic oxide

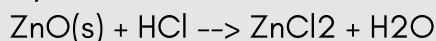
- Aluminium oxide reacts with sodium hydroxide to form sodium aluminate (salt) and water.



In this reaction aluminium oxide behaves as acidic oxide

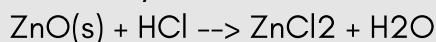
**3.** Zinc Oxides Reactions:

- Zinc Oxide reacts with hydrochloric acid to form zinc chloride and water.



In this reaction, zinc oxide behaves as basic oxide.

- Zinc Oxide reacts with sodium hydroxide to form sodium zincate and water.



In this reaction, zinc oxide behaves as acidic oxide.

### Reaction of Metals with Water

( metal + oxygen  $\rightarrow$  metal hydroxide + hydrogen)

Metals react with water and produce a metal oxide and hydrogen gas metal oxides that are soluble in water dissolve in it to further form metal hydroxide

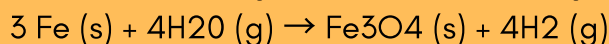
> For Na and K reaction is violent even with cold water and so exothermic that hydrogen immediately fire.



> For Ca , reaction is less violent for hydrogen to catch fire



> Al , Fe don't form hydroxide as their oxides are not soluble.They do not react with the hot water but with steam.



## NCERT ACTIVITY

(AASAN BHASHA MEI)

Reaction of metals with Steam

### Activity 3.10

**CAUTION:** This Activity needs the teacher's assistance.

- Collect the samples of the same metals as in Activity 3.9.
- Put small pieces of the samples separately in beakers half-filled with cold water.
- Which metals reacted with cold water? Arrange them in the increasing order of their reactivity with cold water.
- Did any metal produce fire on water?
- Does any metal start floating after some time?
- Put the metals that did not react with cold water in beakers half-filled with hot water.
- For the metals that did not react with hot water, arrange the apparatus as shown in Fig. 3.3 and observe their reaction with steam.
- Which metals did not react even with steam?
- Arrange the metals in the decreasing order of reactivity with water.

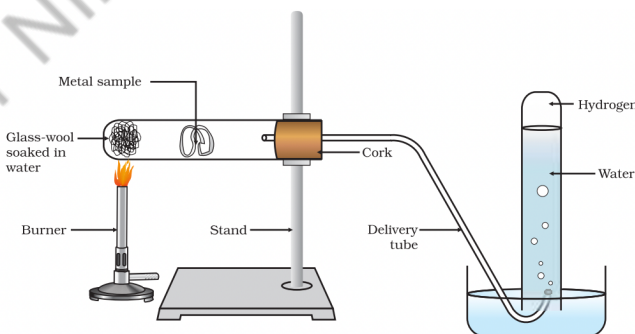


Figure 3.3 Action of steam on a metal

Chalo Ab Ise AASAN BHASHA MEI Samajhte hai :

- A lump of glass wool soaked in water is placed at bottom of tube. The water in glass wool will form steam on heating .
- The Sample of metals placed in the middle of the horizontally kept boiling tube. The boiling tube containing water, soaked glass wool and metal sample is arranged in apparatus.
- To start the experiment, the metal sample is heated by using a burner when the metal gets hot, then the glass wool is heated by using other burner.
- The water present in glass wool forms steam on heating . This steam then passes over the hot metal. The metal react with steam to form the metal oxide and H<sub>2</sub> gas.
- The H<sub>2</sub> gas come out of the boiling tube and it is collected over water when a lighted match stick is applied to gas collected jar, the gas burns with a "pop" sound, indicating that it is hydrogen. The metal oxide formed remains behind in the boiling tube.

- This experiment is performed by taking magnesium, aluminium, zinc and iron as metal sample.
- It is found that the reaction of steam with magnesium is most vigorous followed by reaction with aluminium and zinc but reaction with iron is slowest.
- Magnesium is very reactive whereas the iron is least reactive.
- Decreasing order  $Mg > Al > Zn > Fe$
- Metals like lead, silver and gold do not react with water or even steam.
- Only those metals displace hydrogen from water which are hydrogen in the reactivity series.

### Reaction of Metals with Acids

> All metals (except less reactive like copper, Hg, Ag, Au, Pt) reacts with dilute HCl and dilute  $H_2SO_4$  to produce salt and hydrogen gas.

Metal + dilute acid  $\rightarrow$  salt + Hydrogen

e.g.  $Zn + 2HCl(aq) \rightarrow ZnCl_2 + H_2(g)$

> Two gases not evolved when a metal reacts with nitric acid ( $HNO_3$ ) as it is a strong oxidising agent. It oxidises  $H_2$  produced to  $H_2O$  and itself gets reduced to any of the nitrogen oxides.

But Mg and Mn reacts with very diluted  $HNO_3$  to evolve  $H_2$  gas.

Metal +  $HNO_3 \rightarrow$  Salt +  $NO_2$  /  $N_2O$  +  $H_2O$

For Mn and Mg =  $Mn/Mg + HNO_3 (dil.) \rightarrow$  Salt +  $H_2$



### Kuch Kaam Ki Baat (K<sup>3</sup>B) :

Aqua-Regia: Aqua regia is freshly prepared mixture of 1 part of conc. nitric acid and 3 part of conc. HCl.

- Ratio- conc.  $HNO_3$  : conc. HCl- 1:3, it is a highly corrosive fuming liquid.
- Aqua-regia can dissolve all metals.
- Aqua-regia can dissolve even gold and platinum metals.

### Reaction of Metals with Other Metal Salts

Only more reactive metals can displace a less reactive metal from compound.

$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

$Cu + FeSO_4 \rightarrow X$



### Kuch Kaam Ki Baat (K B) :

#### REACTIVITY SERIES OF

**METAL:** Arrangement of metal in a vertical column in order of decreasing reactivities.

#### Reactivity Series of Metals

These metals are more reactive than hydrogen	Potassium	K	(Most reactive metal)
	Sodium	Na	
	Calcium	Ca	
	Magnesium	Mg	
	Aluminium	Al	
	Zinc	Zn	
	Iron	Fe	
	Tin	Sn	
	Lead	Pb	
	[Hydrogen]	[H]	
These metals are less reactive than hydrogen	Copper	Cu	
	Mercury	Hg	
	Silver	Ag	
	Gold	Au	
			(Least reactive metal)



## Q U E S T I O N S

1. Why is sodium kept immersed in kerosene oil?
2. Write equations for the reactions of
  - (i) iron with steam
  - (ii) calcium and potassium with water
3. Samples of four metals A, B, C and D were taken and added to the following solution one by one. The results obtained have been tabulated as follows.



Metal	Iron(II) sulphate	Copper(II) sulphate	Zinc sulphate	Silver nitrate
A	No reaction	Displacement		
B	Displacement		No reaction	
C	No reaction	No reaction	No reaction	Displacement
D	No reaction	No reaction	No reaction	No reaction

Use the Table above to answer the following questions about metals A, B, C and D.

- (i) Which is the most reactive metal?
  - (ii) What would you observe if B is added to a solution of Copper(II) sulphate?
  - (iii) Arrange the metals A, B, C and D in the order of decreasing reactivity.
4. Which gas is produced when dilute hydrochloric acid is added to a reactive metal? Write the chemical reaction when iron reacts with dilute  $H_2SO_4$ .
  5. What would you observe when zinc is added to a solution of iron(II) sulphate? Write the chemical reaction that takes place.

Answers:

1. Sodium is highly reactive element, that reacts with oxygen when comes in contact with air and burns. Therefore, it is kept immersed in kerosene for prevention.
2. (i)  $3Fe(s) + 4H_2O(l) \rightarrow Fe_3O_4 + H_2$   
(ii) Calcium with water:  $Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + H_2(g)$   
Potassium with water:  $2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g) + \text{Heat}$
3. (i) B- It gives displacement reaction with iron(II) sulphate.  
(ii) Displacement reaction will take place , blue colour of Copper(II) Sulphate solution will fade and red-brown deposit of copper will form on B.  
(iii) B,A,C,D
4. Hydrogen gas is produced.  $\{Fe + H_2SO_4 \rightarrow FeSO_4 + H_2\}$
5. When zinc is added in the solution , the colour of iron sulphate solution changes. As zinc is more reactive than iron, so it displaces iron from its solution and a grey precipitate of iron and a colourless zinc sulphate is formed.





# B. NON-METALS

Those elements which form negative ions by gaining electrons are called **non-metals**.

## Physical Properties of Non Metals

- Are solids or gases except bromine(liquid)
- Except graphite, all are bad conductors of heat and electricity
- Are non ductile
- Have low melting and boiling points
- Are brittle i.e. they breakdown when hammered or stretched.

## Chemical Properties of Non Metals

- Non metals are electron acceptor and cannot supply electrons to  $H^+$  ions of acids to reduce them to hydrogen gas. Therefore, non metals do not react with water steam or dilute acid.
- With  $O_2$ ,  $C + O_2 \rightarrow CO_2$

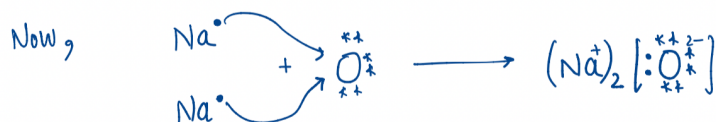
# C. METALS+NON METALS

When metals react with non-metals, they form **ionic compounds** and when non-metal react with a non-metal, they form **covalent compound**.

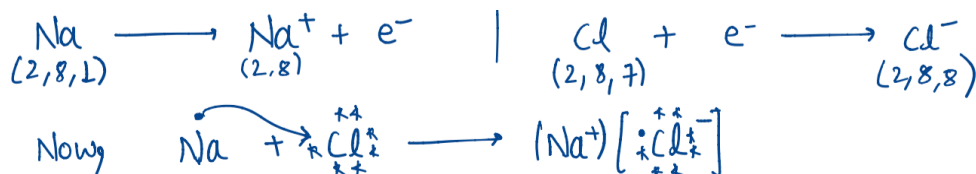
## Ionic Compounds

Formed when a metal and a non-metal react. Metal loses electron(s) which is gained by non-metal in such a manner that octet of both is completely filled. These are also called Electrovalent Compounds.

EX: Formation of  $Na_2O$ :



EX: Formation of  $NaCl$ :





# Properties of Ionic Compounds

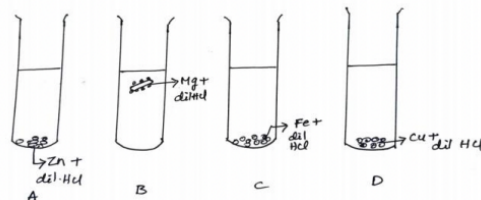
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- Solids and crystalline in nature due to strong force of attraction between positive and negative ion.
- Soluble in water and insoluble in solvents such as kerosene and petrol.
- Good conductors of electricity in aqueous solutions and molten state but do not conduct in the solid state.
- Melting and boiling points are high.

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# QUESTIONS FROM CBSE SQP 2021-22

27. The diagram shows the reaction between metal and dil. acid.



What is the reason for different behaviour of Mg in test tube B?

- Mg is lighter element than dil. HCl
- Mg reacts with dil. HCl to produce  $H_2$  gas which helps in floating
- Mg reacts with dil. HCl to produce  $N_2$  gas which helps in floating
- Mg reacts with dil. HCl to produce  $CO_2$  gas which helps in floating

Ans- B

28. The table shown below gives information about four substances: A, B, C and D.

SUBSTANCE	MELTING POINT (K)	ELECTRICAL CONDUCTIVITY	
		SOLID	LIQUID/ AQUEOUS
A	295	Good	Good
B	1210	Poor	Good
C	1890	Poor	Good
D	1160	Poor	Poor

Identify ionic compounds from the above given substances.

- A, B
- B, C
- A, B, D
- A, C, D

Ans- B

48. A cable manufacturing unit tested few elements on the basis of their physical properties.

Properties	W	X	Y	Z
Malleable	Yes	No	No	Yes
Ductile	Yes	No	No	Yes
Electrical conductivity	Yes	Yes	Yes	No
Melting Point	High	Low	Low	High

Which of the above elements were discarded for usage by the company?

- W, X, Y
- X, Y, Z
- W, X, Z
- W, X, Z

Ans- B

3. Metal X reacts with Dil. HCl to form Metal Salt and Gas. Identify X?

- Copper
- Mercury
- Silver
- Zinc

Ans- D

26. *Even though rain water is the purest form of water, it acts as an electrolyte. However, distilled water cannot be an electrolyte.*

The reason for this is

- A. rain water consists of dissolved oxygen
- B. rain water consists of dissolved oxides of sulphur
- C. rain water consists of dissolved Nitrogen
- D. rain water consists of dissolved oxides of Hydrogen

Ans- B

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# PREVIOUS YEAR QUESTIONS

(Converted into MCQ format)

1. Arrange the following in the decreasing order of their reactivity: Na, K, Cu, Ag. (2009,1M)

A.  $K > Na > Cu > Ag$   
C.  $Ag > Cu > K > Na$

B.  $Na > K > Cu > Ag$   
D.  $Na > Ag > K > Cu$

2. What is the valency of silicon with atomic number 14? (2010,1M)

A. 4  
C. 5

B. 3  
D. 10

3. Calcium floats on water? (2011,1M)

A. True

B. False

4. Which metals are found in nature in a free state ? (2011,1M)

A. Nikle  
C. Gold

B. Platinum  
D. Silver

5. Make a distinction between metals and non-metals with respect to the nature of their oxide. (2011,1M)

Answer: Metallic oxides are basic, few are amphoteric. Non-metallic oxides are acidic, few are neutral.

6. Which non metal is lustrous? (2011,1M)

A. Sulphur  
C. Phosphorus

B. Iodine  
D. Silver

7. Which metal is non-lustrous? (2011,1M)

A. Gold  
C. Sodium

B. Iodine  
D. Silver

8. A green layer is gradually formed on a copper plate left exposed to air for a week in the bathroom. What could this green substance Be? (2012,1M)

A.  $CuCO_3.Cu(OH)_2$   
C.  $CuCO_2.Cu(OH)_2$

B.  $CuCO_3.Cu(OH)_3$   
D.  $CuCO_3.Cu(OH)$

9. What happens when calcium is treated with water?

(i). It does not react with water  
(ii). It reacts violently with water  
(i). It reacts less violently with water  
(iv). Bubbles of hydrogen gas formed, stick to the surface of calcium

(A). (i) and (iv)  
(B). (ii) and (iii)  
(C). (i) and (ii)  
(D). (ii) and (iv)

10. Which of the following oxide(s) of iron would be obtained on a prolonged reaction of iron with steam?
- A. FeO  
B. Fe<sub>2</sub>O<sub>3</sub>  
C. Fe<sub>3</sub>O<sub>4</sub>  
D. Fe<sub>4</sub>O<sub>4</sub>
11. Which one of the following metals would be displaced from the solution of its salts by other three metals?
- A. Mg  
B. Ag  
C. Zn  
D. Cu
12. An element 'X' reacts with O<sub>2</sub> to give a compound with a high melting point. This compound is also soluble in water. The element 'X' is [1M, 2020 Delhi]
- A. Iron  
B. Calcium  
C. Carbon  
D. Silicon
13. Name the constituent metals of Bronze. (2012, 1M)
- A. Gold  
B. Bronze  
C. Sodium  
D. Silver
14. Explain why:
- (i) Ionic compounds in general have high melting and boiling points.  
(ii) Highly reactive metals cannot be obtained from their oxides by heating them with carbon.  
(iii) Copper vessels get a green coat when left exposed to air in the rainy season. [3M, 2009]
- Answer:
- (i) ionic compounds have high melting and boiling points due to the strong force of attraction between oppositely charged ions.  
(ii) It is because these metals themselves are strongly reducing agents. Therefore, it cannot be reduced by reducing agents like carbon.  
(ii) Copper vessels react with CO<sub>2</sub>, O<sub>2</sub> and moisture to form green-coloured basic copper carbonate [CuCO<sub>3</sub>·Cu(OH)<sub>2</sub>].
15. State three reasons for the following facts
- (i) Sulphur is a non-metal  
(ii) Magnesium is a metal
- One of the reasons must be supported with a chemical equation. [3M, 2015]

Sulphur (non-metal)	Magnesium ( metal )
1. Sulphur is neither malleable, nor ductile.	1. Magnesium is malleable and ductile
2. It is poor conductor of heat and electricity.	2. It is a good conductor of heat and electricity
3. Sulphur dioxide is basic in nature.	3. Magnesium oxide is acidic in nature.
$\text{S} + \text{O}_2 \longrightarrow \text{SO}_2$ $\text{SO}_2 + \text{H}_2\text{O} \longrightarrow \text{H}_2\text{SO}_3$ (sulphurous acid)	$2\text{Mg} + \text{O}_2 \longrightarrow 2\text{MgO}$ $\text{MgO} + \text{H}_2\text{O} \longrightarrow \text{Mg}(\text{OH})_2$ (magnesium hydroxide)

16. Property of gold which make it the most suitable metal for ornaments. (2020)

- A. Ductility  
B. Lustre  
C. Both A and B  
D. None of the above

17. Which metal is the best conductor of heat? (2020)

- A. Silver  
B. Gold  
C. Platinum  
D. None of the above

18. Which metal melts when you keep them on your palm? (2020)

- A. Cesium  
B. Gallium  
C. Platinum  
D. Both A and B

19. Statement (A): Sodium and Potassium are highly reactive metals.

Statement (B): Sodium and Potassium are stored underwater.

- (A) Statement 'A' is true, statement 'B' is false  
(B) Statement 'B' is false, statement 'A' is true  
(C) Both statements, 'A' and 'B' are true  
(D) Both statements 'A' and 'B' are false

## PYQ MCQ ANSWERS:

1. a
2. a
3. a
4. c and d
- 5.
6. b
7. c
8. a
9. d
10. c
11. d
12. b
13. b
- 14.
- 15.
16. c
17. a
18. d
19. a
- 20.